IN THE CLAIMS

1. (original) A compound structure for reduced contact resistance to a silicon-containing material, comprising:
a first refractory metal material overlying the silicon-containing material, wherein the first refractory metal material is a conductive material containing a first refractory metal and a first impurity capable of forming a chemical bond with the first refractory metal; and
a second refractory metal material overlying the first refractory metal material, wherein the second refractory metal material is a conductive material containing a second refractory metal and a second impurity capable of forming a chemical bond with the second refractory metal;
wherein the first refractory metal material contains the first impurity at a level less than a stoichiometric level; and
wherein the second refractory metal material has a lower affinity for the first and second impurities than does the first refractory metal material.

2. (original) The compound structure of claim 1, wherein the first impurity is the same as the second impurity.

3. (original) The compound structure of claim 1, wherein the first and second refractory metals are each selected from the group consisting of chromium, cobalt, hafnium, molybdenum, niobium, tantalum, titanium, tungsten, vanadium and zirconium.

4. (original) The compound structure of claim 1, wherein the second refractory metal material can serve as an impurity donor to the first refractory metal material during an anneal or other exposure to heat and wherein the first and second impurities are each selected from the group consisting of boron, carbon, nitrogen and oxygen.

5. (original) The compound structure of claim 4, wherein the first impurity is the same as the second impurity.

6. (original) The compound structure of claim 5, wherein the second refractory metal material contains the second impurity at a level higher than a stoichiometric level and wherein the first refractory metal material contains the first impurity at a level less than a stoichiometric level.

7. (original) The compound structure of claim 4, wherein the first refractory metal is different from the second refractory metal.

8. (original) A compound structure for reduced contact resistance to a silicon-containing material, comprising:

a first refractory metal nitride layer overlying the silicon-containing material, wherein the first refractory metal nitride layer is an unsaturated refractory metal nitride material; and

a second refractory metal nitride layer overlying the first refractory metal nitride layer, wherein the second refractory metal nitride layer has a lower affinity for nitrogen than the first refractory metal nitride layer.

9. (original) The compound structure of claim 8, wherein the first refractory metal nitride layer has a bulk resistivity within 5% of its unsaturated maximum bulk resistivity and wherein the second refractory metal nitride layer contains a saturated refractory metal nitride material.

10. (original) The compound structure of claim 9, wherein the first refractory metal nitride layer contains a different refractory metal than the second refractory metal nitride layer.

11. (original) The compound structure of claim 8, wherein the first refractory metal nitride layer is produced using an ionized metal plasma process.

12. (original) The compound structure of claim 11, wherein the ionized metal plasma process uses a titanium target, a bias power of approximately 0-500W, a coil power of approximately 100-3000W, a nitrogen flow rate of approximately 5-25 sccm, an argon flow rate of approximately 10-50 sccm, and a deposition time of approximately 3-10 seconds.

13. (original) The compound structure of claim 11, wherein the ionized metal plasma process uses a titanium target, a bias power of approximately 300W, a coil power of approximately 2800W, a nitrogen flow rate of approximately 13 sccm, an argon flow rate of approximately 40 sccm, and a deposition time of approximately 6 seconds.

14. (original) The compound structure of claim 8, wherein the first refractory metal nitride layer has a thickness of approximately 20-120Å.

15. (original) The compound structure of claim 8, further comprising a refractory metal silicide interface between the silicon-containing material and the first refractory metal nitride layer.

16. (original) The compound structure of claim 15, wherein the refractory metal silicide interface is limited to a lower portion of the first refractory metal nitride layer.

17. (original) A compound structure for reduced contact resistance to a silicon-containing material, comprising:

a first refractory metal nitride layer overlying the silicon-containing material,

wherein the first refractory metal nitride layer has a refractory metal

component and wherein an atomic ratio of nitrogen to the refractory metal component of the first refractory metal nitride layer is less than one; and

a second refractory metal nitride layer overlying the first refractory metal nitride layer, wherein the second refractory metal nitride layer has a lower affinity for nitrogen than the first refractory metal nitride layer.

18. (original) The compound structure of claim 17, wherein the first refractory metal nitride layer has a bulk resistivity within 15% of its unsaturated maximum bulk resistivity and wherein the second refractory metal nitride layer has a refractory metal component such that an atomic ratio of nitrogen to the refractory metal component of the second refractory metal nitride layer is greater than or equal to one.

19. (original) A compound structure for reduced contact resistance to a silicon-containing material, comprising:

a titanium nitride layer overlying the silicon-containing material, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material having a bulk resistivity within 15% of a maximum unsaturated bulk resistivity; and

a refractory metal nitride layer overlying the titanium nitride layer.

20. (original) The compound structure of claim 19, wherein the refractory metal nitride layer is a tungsten nitride layer.

21. (original) The compound structure of claim 20, wherein the tungsten nitride layer is a nitrogen-rich tungsten nitride layer.

22. (new) A structure for providing ohmic contact to a silicon-containing layer in an integrated circuit, comprising:

a first refractory metal material overlying the silicon-containing layer, wherein the first refractory metal material is a conductive material containing a first refractory metal and a first impurity forming a chemical bond with the first refractory metal;

a first refractory metal silicide interface formed between the first refractory metal material and the silicon-containing layer; and

a second refractory metal material overlying and adjoining the first refractory metal material, wherein the second refractory metal material is a conductive material containing a second refractory metal and a second impurity forming a chemical bond with the second refractory metal;

wherein the first refractory metal material contains the first impurity at a level less than a stoichiometric level; and

wherein the second refractory metal material has a lower affinity for the first and second impurities than does the first refractory metal material.

23. (new) The structure of claim 22, wherein the first and second impurities are each selected from the group consisting of boron, carbon, nitrogen and oxygen.

24. (new) The structure of claim 23, wherein the first refractory metal material further comprises an additional impurity forming a chemical bond with the first refractory metal.

25. (new) The structure of claim 24, wherein the additional impurity is silicon.

26. (new) The structure of claim 22, wherein the first refractory metal is different from the second refractory metal.

27. (new) The structure of claim 22, wherein the second refractory metal material contains the second impurity at a level higher than a stoichiometric level.

28. (new) A structure for providing ohmic contact to a silicon-containing layer in an integrated circuit, comprising:

a first refractory metal nitride layer overlying the silicon-containing layer, wherein the first refractory metal nitride layer is an unsaturated refractory metal nitride material;

a first refractory metal silicide at an interface between the first refractory metal nitride layer and the silicon-containing layer; and

a second refractory metal nitride layer overlying and adjoining the first refractory metal nitride layer, wherein the second refractory metal nitride layer has a lower affinity for nitrogen than the first refractory metal nitride layer;

wherein the first refractory metal nitride layer is formed to have a bulk resistivity within 15% of its unsaturated maximum bulk resistivity.

29. (new) The structure for providing ohmic contact of claim 28, wherein the first refractory metal nitride layer is formed to have a bulk resistivity within 5% of its unsaturated maximum bulk resistivity.

30. (new) The structure for providing ohmic contact of claim 28, wherein the first refractory metal nitride layer is formed to have a bulk resistivity approximately equal to its unsaturated maximum bulk resistivity.

31. (new) A structure for providing ohmic contact to a silicon-containing layer in an integrated circuit, comprising:

a titanium nitride layer overlying the silicon-containing layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material of the form TiN_x where x is in the range of approximately 0.2 to approximately 0.8;

a titanium silicide layer formed at an interface between the titanium nitride layer and the silicon-containing layer; and

a tungsten nitride layer overlying and adjoining the titanium nitride layer.

32. (new) The structure for providing ohmic contact of claim 31, wherein the tungsten nitride layer is a saturated tungsten nitride material.

33. (new) The structure for providing ohmic contact of claim 31, wherein the tungsten nitride layer has a lower affinity for nitrogen than the titanium nitride layer.

34. (new) The structure for providing ohmic contact of claim 31, wherein x is in the range of approximately 0.4 to approximately 0.7.

35. (new) The structure for providing ohmic contact of claim 31, wherein x is in the range of approximately 0.5 to approximately 0.6.

36. (new) A word line for a memory cell, comprising:
a gate dielectric layer;
a silicon-containing layer overlying the gate dielectric layer;
a first refractory metal material overlying the silicon-containing layer, wherein the first refractory metal material is a conductive material containing a first refractory metal and a first impurity forming a chemical bond with the first refractory metal;
a second refractory metal material overlying the first refractory metal material, wherein the second refractory metal material is a conductive material containing a second refractory metal and a second impurity forming a chemical bond with the second refractory metal; and
a conductor layer overlying the second refractory metal material;
wherein the first refractory metal material contains the first impurity at a level less than a stoichiometric level; and
wherein the second refractory metal material has a lower affinity for the first and second impurities than does the first refractory metal material.

37. (new) The word line of claim 36, wherein the first impurity is the same as the second impurity.

38. (new) The word line of claim 36, wherein the first and second refractory metals are each selected from the group consisting of chromium, cobalt, hafnium, molybdenum, niobium, tantalum, titanium, tungsten, vanadium and zirconium.

39. (new) The word line of claim 36, wherein the second refractory metal material can serve as an impurity donor to the first refractory metal material during an anneal or other exposure to heat and wherein the first and second impurities are each selected from the group consisting of boron, carbon, nitrogen and oxygen.

40. (new) The word line of claim 39, wherein the first impurity is the same as the second impurity.

41. (new) The word line of claim 40, wherein the second refractory metal material contains the second impurity at a level higher than a stoichiometric level and wherein the first refractory metal material contains the first impurity at a level less than a stoichiometric level.

42. (new) The word line of claim 39, wherein the first refractory metal is different from the second refractory metal.

43. (new) The word line of claim 42, wherein the first refractory metal is titanium and the second refractory metal is tungsten.

44. (new) The word line of claim 43, wherein the first and second impurities are each nitrogen.

45. (new) The word line of claim 44, wherein the conductor layer is a tungsten layer.

46. (new) A word line for a memory cell, comprising:
a gate dielectric layer;
a silicon-containing layer overlying the gate dielectric layer;
a first refractory metal nitride layer overlying the silicon-containing layer, wherein the first refractory metal nitride layer is an unsaturated refractory metal nitride material;
a second refractory metal nitride layer overlying the first refractory metal nitride layer, wherein the second refractory metal nitride layer has a lower affinity for nitrogen than the first refractory metal nitride layer; and
a conductor layer overlying the second refractory metal nitride layer.

47. (new) The word line of claim 46, wherein the first refractory metal nitride layer has a bulk resistivity within 5% of its unsaturated maximum bulk resistivity and wherein the second refractory metal nitride layer contains a saturated refractory metal nitride material.

48. (new) The word line of claim 47, wherein the first refractory metal nitride layer contains a different refractory metal than the second refractory metal nitride layer.

49. (new) The word line of claim 46, further comprising a refractory metal silicide interface between the silicon-containing layer and the first refractory metal nitride layer.

50. (new) The word line of claim 49, wherein the refractory metal silicide interface is limited to a lower portion of the first refractory metal nitride layer.

51. (new) A word line for a memory cell, comprising:
a gate dielectric layer;
a polysilicon layer overlying the gate dielectric layer;
a titanium nitride layer overlying the polysilicon layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a

nitrogen-containing ambient to produce an unsaturated titanium nitride material having a bulk resistivity within 15% of a maximum unsaturated bulk resistivity;

a refractory metal nitride layer overlying the titanium nitride layer; and

a refractory metal layer overlying the refractory metal nitride layer.

52. (new) The word line of claim 51, wherein the refractory metal nitride layer and the refractory metal layer contain the same refractory metal.

53. (new) The word line of claim 52, wherein the refractory metal nitride layer is a tungsten nitride layer and the refractory metal layer is a tungsten layer.

54. (new) The word line of claim 53, wherein the tungsten nitride layer is a nitrogen-rich tungsten nitride layer.

55. (new) A word line for a memory cell, comprising:

a gate dielectric layer;

a polysilicon layer overlying the gate dielectric layer;

an unsaturated titanium nitride layer overlying the polysilicon layer;

a tungsten nitride layer overlying the unsaturated titanium nitride layer; and

a tungsten layer overlying the tungsten nitride layer.

56. (new) The word line of claim 55, further comprising:

a titanium silicide interface formed between the unsaturated titanium nitride layer and the polysilicon layer.

57. (new) The word line of claim 55, wherein the unsaturated titanium nitride layer has a bulk resistivity as formed within 15% of its unsaturated maximum bulk resistivity.

58. (new) The word line of claim 55, wherein the tungsten nitride layer has a lower affinity for nitrogen than the unsaturated titanium nitride layer.

59. (new) The word line of claim 58, wherein the unsaturated titanium nitride layer has a bulk resistivity as formed approximately equal to its unsaturated maximum bulk resistivity.

60. (new) The word line of claim 55, wherein the unsaturated titanium nitride layer contains a titanium nitride material of the form TiN_x where x ranges from approximately 0.5 to approximately 0.6.

61. (new) A word line for a memory cell, comprising:
a gate dielectric layer;
a conductively-doped polysilicon layer overlying the gate dielectric layer;
an unsaturated titanium nitride layer overlying the conductively-doped polysilicon layer;
a titanium silicide layer at an interface between the conductively-doped polysilicon layer and the unsaturated titanium nitride layer;
a tungsten nitride layer overlying the unsaturated titanium nitride layer and having a lower affinity for nitrogen than the unsaturated titanium nitride layer; and
a tungsten layer overlying the tungsten nitride layer;
wherein the unsaturated titanium nitride layer as formed had a bulk resistivity within 15% of a maximum unsaturated bulk resistivity.

62. (new) The word line of claim 61, wherein the tungsten nitride layer contains a nitrogen-rich tungsten nitride material.

63. (new) A word line for a memory cell, comprising:
a gate dielectric layer;
a conductively-doped polysilicon layer overlying the gate dielectric layer;

a titanium nitride layer overlying the polysilicon layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material having a bulk resistivity within 15% of a maximum unsaturated bulk resistivity;

a titanium silicide interface formed in a lower portion of the titanium nitride layer;

a refractory metal nitride layer overlying the titanium nitride layer; and

a tungsten layer overlying the refractory metal nitride layer.

64. (new) A word line for a memory cell, comprising:

a gate dielectric layer;

a conductively-doped polysilicon layer overlying the gate dielectric layer;

a titanium nitride layer overlying the polysilicon layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material of the form TiN_x where x is in the range of approximately 0.2 to approximately 0.8;

a titanium silicide interface formed in a lower portion of the titanium nitride layer;

a refractory metal nitride layer overlying the titanium nitride layer; and

a tungsten layer overlying the refractory metal nitride layer.

65. (new) The word line of claim 64, wherein x is in the range of approximately 0.5 to approximately 0.6.

66. (new) A method of providing ohmic contact between a silicon-containing layer and a conductive layer in an integrated circuit, the method comprising:

forming a first refractory metal material on the silicon-containing layer, wherein the first refractory metal material is a conductive material containing a first refractory metal and a first impurity capable of forming a chemical bond with the first refractory metal, and wherein the first refractory metal

material contains the first impurity at a level less than a stoichiometric level;

forming a second refractory metal material on the first refractory metal material, wherein the second refractory metal material is a conductive material containing a second refractory metal and a second impurity capable of forming a chemical bond with the second refractory metal, and wherein the second refractory metal material has a lower affinity for the first and second impurities than does the first refractory metal material;

annealing to form a refractory metal silicide interface between the first refractory metal material and the silicon-containing layer; and

forming the conductive layer on the second refractory metal material, wherein the conductive layer comprises a third refractory metal.

67. (new) The method of claim 66, wherein the first and second impurities are each selected from the group consisting of boron, carbon, nitrogen and oxygen.

68. (new) The method of claim 66, wherein the first impurity is the same as the second impurity and the second refractory metal material contains the second impurity at a level higher than a stoichiometric level.

69. (new) The method of claim 66, wherein the first refractory metal is different from the second refractory metal.

70. (new) The method of claim 69, wherein the second refractory metal and the third refractory metal are the same refractory metal.

71. (new) The method of claim 66, wherein forming the first refractory metal material further comprises forming the first refractory metal material using a technique selected from the group consisting of chemical vapor deposition and physical vapor deposition processes.

72. (new) The method of claim 71, wherein the physical vapor deposition process is selected from the group consisting of sputtering and ionized metal plasma processes.

73. (new) The method of claim 66, wherein the first refractory metal material is doped with the first impurity in a reactive process during formation.

74. (new) The method of claim 66, wherein forming the first refractory metal material further comprises doping a layer of first refractory metal with the first impurity after forming the layer of first refractory metal.

75. (new) The method of claim 66, wherein forming the first refractory metal material further comprises forming the first refractory metal material to contain the first refractory metal, the first impurity capable of forming a chemical bond with the first refractory metal and an additional impurity capable of forming a chemical bond with the first refractory metal.

76. (new) The method of claim 75, wherein forming the first refractory metal material further comprises forming the first refractory metal material by a chemical vapor deposition process.

77. (new) The method of claim 76, wherein the chemical vapor deposition process comprises using a chemistry of titanium tetrachloride ($TiCl_4$), silane (SiH_4) and ammonia (NH_3).

78. (new) A method of providing ohmic contact to a silicon-containing layer in an integrated circuit, the method comprising:

forming a first refractory metal nitride layer on the silicon-containing layer,

wherein the first refractory metal nitride layer is an unsaturated refractory metal nitride material;

forming a second refractory metal nitride layer on the first refractory metal nitride layer, wherein the second refractory metal nitride layer has a lower affinity for nitrogen than the first refractory metal nitride layer; and

annealing to form a refractory metal silicide interface between the first refractory metal nitride layer and the silicon-containing layer.

79. (new) The method of claim 78, wherein the silicon-containing layer is selected from the group consisting of conductively-doped polysilicon and conductively-doped monocrystalline silicon.

80. (new) The method of claim 78, wherein forming the first refractory metal nitride layer on the silicon-containing layer further comprises forming the first refractory metal nitride layer using a chemical vapor deposition process.

81. (new) A method of providing ohmic contact to a silicon-containing layer in an integrated circuit, the method comprising:

forming an unsaturated titanium nitride layer on the silicon-containing layer;

forming a saturated tungsten nitride layer on the unsaturated titanium nitride layer; and

annealing to form a titanium silicide interface between the unsaturated titanium nitride layer and the silicon-containing layer.

82. (new) The method of claim 81, wherein the silicon-containing layer is selected from the group consisting of conductively-doped monocrystalline silicon and conductively-doped polysilicon.

83. (new) The method of claim 81, further comprising forming a tungsten layer on the tungsten nitride layer.

84. (new) A method of providing ohmic contact to a silicon-containing layer in an integrated circuit, the method comprising:

forming a titanium nitride layer on the silicon-containing layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material of the form TiN_x where x is in the range of approximately 0.2 to approximately 0.8;

forming a refractory metal nitride layer on the titanium nitride layer, wherein the refractory metal nitride layer has a lower affinity for nitrogen than the titanium nitride layer; and

annealing to form a refractory metal silicide interface between the titanium nitride layer and the silicon-containing layer.

85. (new) A method of providing ohmic contact to a silicon-containing layer in an integrated circuit, the method comprising:

forming a titanium nitride layer on the silicon-containing layer, wherein the titanium nitride layer is formed by reactive sputtering from a titanium target in a nitrogen-containing ambient to produce an unsaturated titanium nitride material having a bulk resistivity within 15% of a maximum unsaturated bulk resistivity;

forming a refractory metal nitride layer on the titanium nitride layer, wherein the refractory metal nitride layer has a lower affinity for nitrogen than the titanium nitride layer; and

annealing to form a refractory metal silicide interface between the titanium nitride layer and the silicon-containing layer.

86. (new) A method of providing ohmic contact to a silicon-containing layer in an integrated circuit, the method comprising:

forming an unsaturated titanium nitride layer on the silicon-containing layer using an ionized metal plasma process;

forming a tungsten nitride layer on the unsaturated titanium nitride layer; and

annealing to form a refractory metal silicide interface between the unsaturated titanium nitride layer and the silicon-containing layer.

87. (new) The method of claim 86, wherein the tungsten nitride layer has a lower affinity for nitrogen than the titanium nitride layer.

88. (new) The method of claim 86, wherein the ionized metal plasma process uses a titanium target, a bias power of approximately 0-500W, a coil power of approximately 100-3000W, a nitrogen flow rate of approximately 5-25 sccm, an argon flow rate of approximately 10-50 sccm, and a deposition time of approximately 3-10 seconds.

89. (new) The method of claim 86, wherein the ionized metal plasma process uses a titanium target, a bias power of approximately 300W, a coil power of approximately 2800W, a nitrogen flow rate of approximately 13 sccm, an argon flow rate of approximately 40 sccm, and a deposition time of approximately 6 seconds.